Applications of High-Precision γ-Spectroscopy Papers Presented at the July 1998 Workshop at the University of Notre Dame

Preface

This Special Issue of the Journal of Research of the National Institute of Standards and Technology contains papers from an international workshop on the Applications of High Precision γ-Spectroscopy held on the campus of the University of Notre Dame, July 1-3, 1998. These applications extend from the study of nuclear level-schemes, level-lifetimes, and fundamental constants to investigation of atomic collision cascades, and the location of impurities in solids. Problems lending themselves to such investigations are seen to arise in astrophysics, nuclear, atomic, and condensed matter physics. The techniques and facilities used in these various applications range from semiconductor ionization spectrometers to crystal diffraction instruments while the measurements are carried out at accelerators, nuclear reactors, and/or spallation sources. The goal of this workshop was to provide a forum for the discussion and exchange of ideas on the present use and future developments of High-Precision γ-Spectroscopy.

The format of the workshop included a number of longer invited talks followed by contributed papers on a given topic with ample time allotted for discussions. This gathering included some 53 participants from 10 countries. Their numerous contributions can be seen in the following Program listing, and in the papers included in this Special Issue. A similar gathering had taken place previously on October 4-7, 1992, at the Institut Laue-Langevin (ILL) in Grenoble, France, where there were 60 participants coming from 12 countries. The changes in the scope and perspective between these meetings show increased diversity in the range of applications, a higher level of spectroscopic performance, extension of high resolution spectroscopy to higher energies, increased sophistication of the modeling procedure, and the practical realization of several opportunities whose potential could only be glimpsed at the time of the Grenoble meeting.

The very successful programs of γ-Spectroscopy at the ILL and elsewhere had certain limitations in the range of accessible energies, available resolution, and measurement accuracy. A new impetus in this area was provided by the successful development of GAMS4, a double-flat-crystal spectrometer operated as a joint facility at the High Flux Reactor of the ILL. The concept for the instrument was developed and tested at the National Institute of Standards and Technology [NIST—previously the National Bureau of Standards (NBS)] in the early 1970s. The earliest work was done with long-lived, relatively low-energy sources activated in the NBS reactor. There it was shown that high-resolution, high-accuracy γ-ray spectroscopy could be realized by a transmission geometry, two-crystal instrument, calibrated from first principles, and guided by laser-based angle interferometry.

The move to ILL was motivated by the need for prompt, high-energy, high-intensity sources available at the High Flux reactor with its higher neutron fluxes, and the possibility of having an in-pile source. The implementation, further development, and expansion of this concept at ILL was carried out through the joint and dedicated efforts of Ernest Kessler (NIST), Geoffrey Greene (NIST), M. Scott Dewey (NIST), and Hans Börner (ILL) in spite of the fact that the United States of America was not and is not a member of the ILL consortium of users. This long-standing collaboration between NIST and the ILL, involving significant sharing of the needed financial and human capital investments, has enabled the developments evident in this Special Issue on Applications of High-Precision γ-spectroscopy. While a significant portion of the papers included in this Special Issue result from the use of GAMS4, future benefits of a curved double-crystal spectrometer (GAMS5) seem very promising.

To the extent that the scientific contributors to this meeting have benefited from the capabilities offered by GAMS4, (and may be further benefited in the future by GAMS5), they, and we, are indebted to the successive Directors of the ILL over the past 20 years. Each of these directors, irrespective of his disciplinary perspective, has evidenced a broadly supportive view of the disparate character of the ILL enterprise, allowing it to include even the unusual body of work that is the subject of these proceedings. Finally, we acknowledge the generous financial support of the Graduate School, the College of Science, and the Department of Physics of the University of Notre Dame.

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